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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/030,867	04/29/2002	Masanori Kimura	81839.0105	8937

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EXAMINER	
ANDERSON, MATTHEW A	
ART UNIT	PAPER NUMBER
1722	

DATE MAILED: 04/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/030,867

Applicant(s)

KIMURA, MASANORI

Examiner

Matthew A. Anderson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 October 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 April 2002 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/15/2004 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 4,1-3,5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kojima et al. (US 6,458,202 B1 in view of Ito (JP01040668)).

Kojima et al. discloses a Cz method of pulling a single crystal silicon ingot having a uniform thermal history. (see abstract) The power supplied to the side heater is maintained constant throughout the growth of the main body and end cone of the ingot. The power supplied to the bottom heater is gradually increased during the second half of the growth process. The number of defects in the ingots is decreased versus the

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conventional process. In col. 10 lines 15-35 it is relayed that the bottom heater is used after about 40%-60% or more of the main body has formed. The cooling rate is described as less than 5% variable in the main body of the ingot. In col. 6 lines 5-25 (see also Fig. 1A) the basics of Cz pulling are described including a crucible charged with raw material, a surrounding side heater, and a pulling shaft or wire for withdrawal of the seed crystal from the melt to form the ingot. A steel container encloses the apparatus. Bottom heaters are also provided.

Kojima does not describe utilization percentage of the bottom heater in terms of weight of the ingot withdrawn versus the original raw material weight. Also, heating of the raw material between pulling cycles is not detailed.

Ito et al. discloses a method for growing a semiconductor single crystal by the Czochralski (Cz hereafter) pulling method. A quartz crucible is filled with raw material and heated to form a melt. Side heaters (3) and bottom heaters (4) are used in the heating process. A seed crystal is then contacted with the melt and slowly pulled up to form a single crystal ingot. A chamber (1) surrounds the crucible and heaters. The raw material is rapidly and effectively melted (abstract) by increasing the temperature uniformly across the crucible (Fig. 3 graph where the circles are the present invention).

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the raw material melting use of the bottom heater (Ito) with the growth use of the bottom heater (Kojima) because then turn-around time between uses of the apparatus would have been reduced and more product could have been made. Ito suggests the bottom heater allows rapid and effective raw material melting.

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In respect to claim 4, it would have been obvious to one of ordinary skill in the art at the time of the present invention to not allow solidification of the remaining melt between batch cycles because this would require additional heat and time to be used in re-melting the remaining raw material along with the new raw material added to the crucible for the next batch cycle.

Also, in respect to claim 4, it would have been obvious to one of ordinary skill in the art at the time of the present invention that the electric power supplied to the subsidiary heating means be increased when raw material was introduced because the heat required to form a liquid from a solid (i.e. the heat of fusion) would represent a higher heat requirement than simply maintaining a liquid melt remaining in the crucible. This optimization of heat input would have been obvious to one of ordinary skill in the art at the time of the present invention and would have been achieved with only routine optimization. The examiner notes that the Cz method described by includes adding a solid phase raw material to the crucible and melting that raw material to form a liquid melt. Then, a single crystal is pulled from the melt. (The heat of fusion would have been common knowledge to one of ordinary skill in the art; See Sears et al., University Physics, 7th Ed., Addison Wesley Pub. Co., pp. 363-365, 1987.)

In respect to claim 1, it would have been obvious to one of ordinary skill in the art at the time of the present invention, however, to grow such a Si ingot using a bottom heater powered after 60% (by weight) of the Si ingot has been grown because Kojima suggest using bottom heating after 60% (by length) of the Si ingot is grown and the

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length and weight of Si were known to be directly related. From elementary definitions of density and from geometry of a cylindrical ingot:

$$(L * A) * D = W$$

where: L = ingot length
 A = ingot cross-sectional area
 D = Si density (constant at constant growth
 temperature)
 W = Si ingot weight

In respect to claim 2, it would have been obvious to one of ordinary skill in the art at the time of the present invention to keep the thermal gradients constant (i.e. uniform) in the ingot throughout all stages of the growth because Kojima et al. specifically suggests this in the first line of the abstract.

In respect to claims 3 and 5, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the power values of the main heater and the bottom heater and to control these power values during the growth because Kojima suggest control of the heaters (Col. 13 line 25-35) and optimization of the power sent to the heaters due to operational parameters including the hot zone design (col. 13 lines 40-55).

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is not clear whether the phrase "...should be constant irrespective..." is a definite limitation. (Examiner's Note: this was assumed to be a guideline and not a limit above.)

6. Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The phrase "...controlled to be as near the target value or values as possible..." is not definite. The boundary between acceptably close and not acceptably close to the target value is not definite. Above, the examiner assumed the controlled heat followed the target value precisely.

7. Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The phrase "...should not be solidified..." is not definite. The phrase "...according to..." is not definite in that no definition of the metes and bounds of the increase in electric power supplied is given. The examiner above made the assumption that the melt was not solidified. The assumption that the heater power increase was optimized was also made.

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8. Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The phrase "...near the target value as possible..." is in definite as to its limitation on the metes and bounds of the claim. Above, the examiner assumed the controlled heat followed the target value precisely.

Response to Arguments

9. Applicant's arguments filed 10/15/2004 have been fully considered but they are not persuasive.

The argument that the added limitation to claim 4 renders the claim allowable is not persuasive. One of ordinary skill in the art would realize that solid raw material must be supplied with the heat of fusion in addition to any heat required to raise its temperature if it is to be melted. This comes from basic engineering thermodynamics and physics as evidenced by the textbook of Sears et al.

Conclusion

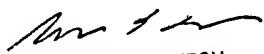
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (571) 272-1459. The examiner can normally be reached on M-F, 8:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (571) 272-1137. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MAA
March 28, 2005


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